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ABSTRACT

This report explores the development of modular education and its application in the Dutch Open University. The origins of modular education are examined from the first applications in American higher education and the development of electives and the credit system to the role of modular instruction as the basis of higher education curriculum. Advantages of modular instruction include more choice and self-pacing for students; more variety and flexibility for teachers and staff; and increased adaptability of instructional materials. Disadvantages include greater self-discipline and self-motivation required for students, increased preparation time and lack of concrete rewards for teachers and staff, and greater administrative resources needed to track students and operate multiple modules. Changes in educational practices in the Dutch speaking world are reviewed, comparing traditional to modular approaches. The modular education program at the Dutch Open University, is described, including three modular course models (study unit model, the textbook-workbook model, and the essay/thesis model) with the advantages and disadvantages of each one outlined. Finally, the paper looks at the importance of prior knowledge, suggesting that in a modular education environment, according to the changing ideas in today's society on personal development, students will request a kind of instruction more fully in accordance with and appropriate to their personal characteristics and their prior knowledge state resulting in a more efficient and effective education for the learner. There is also the opportunity for students to skip a module or to work through it more quickly on the basis of prior knowledge. (Contains 27 references.) (ND)

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Modularisation and student learning in modular instruction in relation with prior knowledge

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The research is directed at a clear definition of the problems and their solutions.

Educational Technology Innovation Centre

Open University

MODULARISATION AND STUDENT LEARNING IN MODULAR INSTRUCTION IN RELATION WITH PRIOR KNOWLEDGE

OTIC Research Report 8

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Summary

Modular education is first adopted in American higher education. From the first introduction of the elective system in 1869 at Harvard University till now, there has been a great variety in the definition and use of modular instruction and the implementation of modularisation.
Today there is a distinction between the common view of modularisation and a more recent and fundamental view. In this report we posite this more fundamental view, which starts from the fact that implementation of modular instruction or modularisation is a radical change of the existing educational setting. This change will be manifested in consequensces towards the educational program, the study materials, the students, the teachers, the students and the organisation as a whole. As with every educational adaptation, modularisation too has its advantages and disadvantages.
Before we give an outline of the way in which modular instruction is realised at the Dutch Open university, a comparision of the characteristics of traditional courses and modular courses is made. Modular instruction at the Dutch Open University has found its shape in the application of various course models. The main models are described shortly.
The final chapter of this report focusses on the link between modularisation and the current knowledge state of students: one thinks of instruction fully in accordance with personal needs and the prior knowledge of students, opportunities to work at their own pace, individual study paths and multifunctionality of modules.
In short, one can call 'flexibility' and 'individualisation' the core concepts of modularisation, if the prior knowledge state of students is taken into account at a reasonable level.

Introduction

There are various reasons for the increasing interest in modular education in the Netherlands in the last few decades. Cutbacks by the government and the associated restructuring and reorganization play a role, as do the wide range of student requirements and the demand from employers for flexible graduates. For the consumers of education, modularisation means an increase in freedom of choice; and for those who provide education, an increased access and/or consumption of the educational supply.
In this report, we shall examine the origins, significance and pros and cons of the use of the modules in education. Modular education at the Dutch Open University will then be described and compared with traditional education. Finally the importance of the student's prior knowledge state in modular education and related applications will be examined, as far as relevant for the 'prior knowledge' research project.

1. The modularity hypothesis and modular instruction

1.1. The origins of modular instruction

Nobody seems to be entirely clear about where "modular instruction" and the "modularity" wave came from. Some look for definitions in dictionaries, others mention the first applications in American and Canadian universities. It seems that some do look for the roots of "modularity" in psychological research and in those theories which fall under the heading of the theory of mind or cognitive psychology. The rationale for modular instruction there seems to reside in the modularity hypothesis. According to Brewer and Nakamura (1984), research has shown that the mind can be looked upon as modular and that it is necessary to develop different types of theoretical entities to account for the different cognitive processes (see Chomsky, 1980, for a similar argument). Of course, next to this hypothesis a lot of other assumptions stay unnoticed.

Modular education, as we now know it, was first adopted a century ago in American higher education. Educational philosophy ensured the growing acceptance of "student-centred learning" and of John Dewey's advocacy of self-realization in the pursuit of studies adapted to the individual's interest.

Harvard University introduced the elective system in 1869 to replace the set curriculum. As a result of this students were able to determine, themselves, which courses they wanted to take (freedom of learning and increased specialization options).

By 1884, Harvard students had almost complete freedom of choice. In the 1890s there was a shift towards measuring progress towards a degree on the basis of the accumulation of individual courses rather than the completing of a total course of study (Burn, 1974). In the meantime other institutions were adopting similar practices.
The movement towards electives was soon accompanied by increasing recognition of a need to quantify educational process, allowing students' progress along the various paths towards a degree to be assessed.

The first units of measurement were the courses themselves, defined in terms of hours of classroom contact, with the measure of achievement across the varied course offerings based on a common time unit (Heffernan, 1973).
Thus emerged the credit system, the forerunner of modules, as a means of aggregating the series of varied educational experiences. Here too, one sees the origins of the view that American higher education allows students total freedom of choice, a kind of cafeteria system in which the moving tray is heaped with whatever fancy catches the mover's eye.
Such was certainly not the intention. The elective/credit system's proponents saw it, not as curricular free-for-all, but as a means of breaking the stranglehold of the classical curriculum.

However the elective system was not introduced across the board in higher education, as schools gave preference to adapting to the entrance requirements /criteria of colleges and universities.

By way of compensation, a number of institutions had introduced a major and minor system, where the student chose some department or group of studies in which he took a major, for example a serie of courses presented by that department, and one in which he took a minor.
Today, the credit system has been used to accommodate a whole range of approaches undreamt of at its creation: self-paced courses and independent study (Ziegler, 1972; Allen & Christensen, 1974); life credits for mature students (Hill, 1975); contract learning (Lindquist, 1975), the forerunner of our negotiated learning; credit for study abroad (Haas, 1982), and developments in the direction of non-attendance (Burn, 1974) and towards award of credit by mastery of content and examination (Lorimer, 1962; Spurr, 1970), and the abandonment of letter/numerical grades for satisfactory/un-

satisfactory (Schultz, 1973) assessments.
As will be apparent, the credit system is capable of movement in virtually any direction: towards greater or less student autonomy, enhanced or reduced institutional control, greater curricular cohesion or more fragmentation.

1.2. Modules and implementation of modular instruction: a common and a more fundamental point of view.

Dictionary definitions of module tend to suggest three underlying concepts : 1) measurement, 2) a part of a whole, and 3) repetition. The term module, therefore features in construction work, especially in the erection of buildings, and it is employed to designate items of furniture which can be assembled variously over time by the purchaser.

In education, there has been a plethora of uses, for example, in timetabling to indicate a period of teaching/learning (Allen & Christensen, 1974), and in modular instruction to represent self-contained sub-courses in a programme of self-instructional material. In the United States, the previous uses are fairly commonplace. However, more traditional courses are described in terms of credit hours, and the general structure in which they function is known as the credit system. In Britain, it should be observed that "module" is used, most commonly, for credit hours; and "modular structure/course" for the credit system, noting by way of caveat that modules go by a variety of other names, e.g. units, blocks, course units, unit courses, courses (Theodossin, 1986).

The common and the more fundamental view on modularisation.

The plethora of uses has led, in particular in a complex situation as is higher education, to several definitions and views.
In the common point of view - one could say the traditional or perhaps the obsolete point if view - , a module can be described as an independent educational unit of limited scope provided with a series of educational and learning activities, which lead to a well described final level (Van Eijl, 1987). At policy level, the module is seen as a useful programming unit with a predetermined scope and duration. It says to make educational programmes easier to set up and change and makes flexible use of education possible. It needs to be stressed, that this view is very limited. Within the whole operation of modularisation, the module is the central

point. Van Eijl (1987) talks about compulsory and non-compulsory characteristics of modules.

The conviction that the flexibility of education can be increased by using modules, that the emphasis in this type of education is on self-instruction systems and on the individual learning paths of the students, has induced a new view on the implementation of modular instruction.

In this more fundamental view, modularisation is much more than cutting pieces. This recent view starts from the fact that the implementation of modular instruction or modularisation is a radical change in the existing educational setting, which has consequences towards the educational program, the study materials, the teachers, the students en the organization as a whole. It must be stressed that intervention into only one or few of these aspects is insufficient to guarantee a successful modularisation.
In this view modularisation leads to an institution focused on facilitating individual learning processes (de Wolf, 1989). Moreover, implementing modular instruction has consequences for five components of higher education, all of which are in phase with each other:

1. the educational program will be divided into independent learning units;
2. the students start from different entry levels, i.e. their prior knowledge state ,their background and their needs and can choose different learning paths;
3. the teachers have to prepare and to give their courses in different ways; they have no longer one year or more to lead a group of students towards a set of final objectives;
4. the learning materials will play a more important role;
5. and to make all this possible a lot of organizational facilities will be necessary.

The difference between the common and the more fundamental point of view on modularisation is outlined in the following schemas (figures 1 and 2).

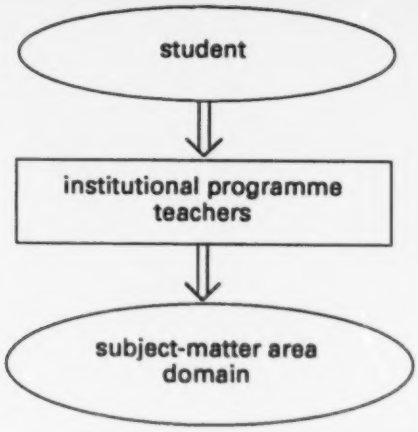

Figure 1: Schematical representation of the common, obsolete view on modularisation.

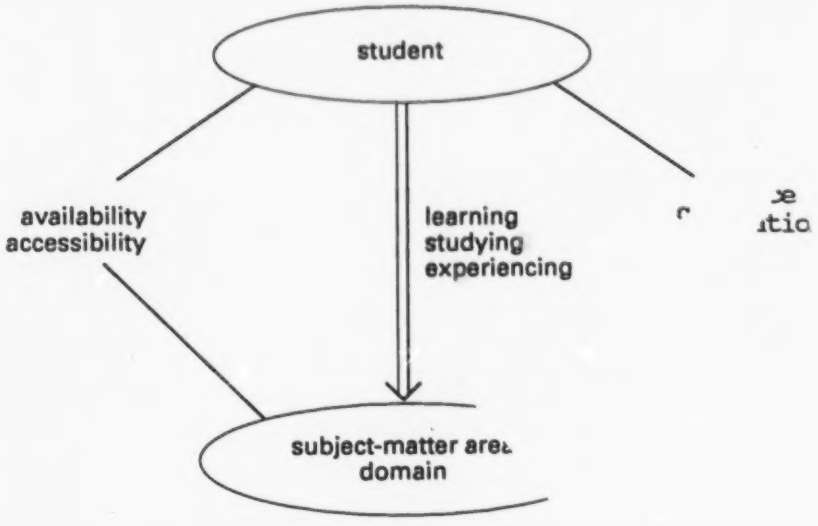

Figure 2: Schematical representation of the new, more fundamental view on modularisation.

In the common view, a module is a concise part of a curriculum with a defined entry-level and exit-level. The teacher takes decisions about the media on the basis of instructional reasons, typical for this module.

The more fundamental view on modularisation stresses that the student is the determinator in the whole instructional process. A module is a part of a learning process. The student is learning, studying and experiencing while moving towards mastering the subject-matter area. The students takes thew availability and accessibility of subject matte into account. He uses the educational materials he finds appropriate, he asks for guidance or assessment to a teacher or subject-matter expert. At the institutional level, the educational media, the guidance and tutoring can play a role in different modules related to the same or another domain.

1.3. Options for modular education

The consequences of modularisation can be looked upon as positive or negative, as advantages or disadvantages.
First, in the case of the students, their option for modular instruction would be understandable.
The advantages of modularisation for students can be identified as being that:

It allows the student to proceed at his own rate. The belief that self-pacing is desirable is based on the generally accepted assumptions that learners do not achieve at the same rate and are not ready to learn at the same time (Burns, 1971).

It allows the student to choose his own learning mode. Choice among different learning modes is desirable, if we assume that learners solve problems and learn, using different techniques based on unique behavioral repertoires or prior knowledge (Burns, 1971). Modular instruction may therefore include a large variety of instructional activities, such as reading textbooks and articles, examining photographs and diagrams, viewing videofilms and computer programs, examining demonstration materials, participating in projects and experiments, and participating in relevant "extra curricular" activities.

It provides a choice among a large variety of topics within any given "course" or discipline, if we assume that students do not possess the same pattern of interest and are not motivated to achieve the same goals (Burns, 1971).

It allows students to identify their strengths and weaknesses and to "recycle" through remedial modules, repetition, or a change in learning mode (Klingstedt, 1971), if we assume that it is desirable to save student time (frequent evaluation permits early diagnosis) and to allow as many students as possible to attain the stated objectives (Goldschmid and

Goldschmid, 1973). Recycling means also that the student does not have to restudy large amounts of subject content.

Moreover students can be tested earlier, progress and measures can be brought into line (control of duration of study);

Also, towards teachers and staff some advantages can be stated:

- a variety of instructional modes are possible within a module;
- modules are set up by an interdisciplinary team of experts;
- staff work can be reduced by means of self studycomponents with emphasis on the accompanying written materials;
- concentrated teaching sessions for the staff, consequently providing more time for other activities;
- the option of developing new modules in that time, adjusting modules to meet the results of research and testing or the supply of education;

Advantages for the learning materials can be stated as follows:

- the material can be presented thematically or in an integrated form;
- the material can be divided into functional units;
- the material can be adopted to the student's learning process;

Furthermore, relating to the organizational facilities, one can say that:

- more planning and developing options for programme designers;
- and the multifunctionality of modules can be seen as profitable;

Finally, the educational program profits from:
- the exchange of modules with other institutions;
- and the fact that modules can be multifunctional.

1.4. The disadvantages of modularisation.

Modular instruction can also have a number of possible disadvantages - or problems perhaps (Goldschmid and Goldschmid, 1973).

What students need to and often do not realize beforehand, is that:

- Self-discipline has to be demonstrated in pursuing independent study;
- The shift from the lecture method (passive) to modular instruction (active) might be difficult for students;
- Choice among the available resources (e.g. different instructional modes, modules, etc.) might prove frustrating;
- The self-pacing nature of modular instruction may have a delicate side-effect. Since some of the students will be fast and others slow learners and students will have more or less prior knowledge, learning efficiency and student output will be totally different among students;

For teachers and staff disadvantages could be:

- The time required to design modules is usually a major problem. Other professional activities compete with a professor's teaching and course-preparation time;
- Lack of concrete rewards may be a problem. Attempts to innovate instruction and, as is the case, to optimalize learning is often not rewarded;
- The professor no longer has "center-stage billing" : his feeling of authority vis-à-vis the "audience" (his students) enhanced through one-way communication in traditional instruction, is diminished or eliminated. He might resent this loss;
- The shift from the lecture method (passive) to modular instruction (active) might also be difficult for them;

According to the educational materials, the time required to design modules is usually a major problem. Experience has thaught that designing and construction of materials (written and CAI) takes more time and needs more expertise as planned.

A problem for the program of the institution can be stated as follows:

- Switching between modules can arise when there is too little structure in the modular trajectories, so that the student does not see the connection between them.

Organizational facilities could, in some cases, be an obstacle:

- Additional clerical time might be necessary to record which students have completed what modules, etc.;
- Additional personnel may be required to assist in the setting up and running of equipment for several modules at a time;
- Access to the instructional resources has to be maximized;
- Grading and exam procedures must be adapted to modular instruction;

1.5. A comparison between traditional and modular instruction.

From 1960, there was a change in educational ideas too in the Dutch speaking world. In educational practice there were a number of necessary changes. We can characterise these changes on a theoretical scale. A synopsis of the changed educational views is given in table 1 (Dochy and Van Luyk, 1987). We emphasize that we are speaking of a theoretical difference; consequently, in practice the division isn't that strict.

Traditional views	New views
1. Knowledge is knowing that	Education is knowing that and knowing how.
2. First theory than practice	Theory and practice in the curriculum
3. Subject-based education	Integrated education
4. Teacher-centred education	Student-centred education
5. Transmission of knowledge	Acquisition of knowledge
6. Educational programm	Study programms
7. Staff direct and teach	Staff assist, stimulate and evaluate

Table 1: Changed educational ideas (taken from Dochy and Van Luyk, 1987).

Most of these new insights are implemented in modular education. The modular course had from its inception a configuration which has accorded with the tendency for change.
An overview of the differences between traditional and modular instruction is presented in table 2. The differences, mainly according to Postlethwait and Russell (1971), must be seen as a general, e.g. applicable for all kinds of modular instruction, such as open distance education at the Open university or problem-oriented education at the University of Limburg. Again, the polarisation is a theoretical one. In the practice of modularisation, some of the characteristics move on a continuum between the stated poles.

Characteristic	Traditional Course	Modular Course
Course success	Mostly judged subjectively by the instructor	Objectives and evaluation assure that the instructor is able to correct faultly instructional materials and knows when his course is successfull in terms of student-learning
Instructional activities	Mostly lectures and written assignments; media used on basis of instructor's personal feelings about them	Many different instuctional activities are used to optimalize learning; media used on efficacy established through trial use by students
Learning experience	Oriented towards teacher performance, with emphasis on teaching; knowledge transfer by the instructor	Oriented towards student performance and individual instruction with emphasis on learning; knowledge acquisition by the student
Mastery	It is expected that only a few students will do very well and some will fail	All students are expected to achieve mastery of the objectives at their own rates
Objectives	Usually not stated in precise observable terms	Stated in terms of students behaviors and presented before instruction begins
Participation	Passive	Active

Presentation of materials	Group-oriented at predetermined times and places	Highly individualized materials; each student can any or all of the instructional materials, available at preferred times and places
Rate (or pacing)	Students must all go at the same rate	Each student can proceed at his own rate
Reinforcement	Usually only after examinations	Immediate and frequent, after small units of material studied
Role of instructor	Disseminator of information	Diagnosis, prescriber, motivator and resource person
Testing	Student typically takes one or two tests on the materials which determine his grade for the entire course	Designed to measure mastery of the objectives stated at the beginning of the course; purposes are assessment of prerequisite skills, diagnosis of strenghts, weaknesses and mastery

Table 2: An overview of differences between traditional and modular instruction.

In the following section we will explain briefly the nature of modular education as it is used till now at the Dutch Open University. For a more extended and detailed elaboration of this matter we refer to Van den Boom et al (1988a, 1988b), Van den Brink (1989) and Van der Linden (1987).

2. Modular education at the Dutch Open University.

The programme offered by the Open University does not comprise complete pre-programmed disciplinary or year programmes, but independent courses which can be taken separately by the student in order to reach a totality of interrelated objectives. The courses are developed within fields of study. These areas are interrelated wholes of knowledge and insight within which the different academic disciplines are represented.

A distinction is made among fields of study such as Law/Legal Studies, Economics, Business and Management Study, Technology, Natural Science, The Humanities and Social Science. A course is developed within a particular field, but will in many cases include elements from other fields. Furthermore the structure in which the courses are produced - a matrix structure in which course teams are brought together from one, or more disciplines supplemented by educational technologists - chosen so that the courses have a largely multi-disciplinary character. A course can therefore be applied to programmes within various fields (multifunctionality).
A course comprises, two or sometimes three modules which require 100, 200 or 300 hours of study respectively.
There is often a combination of media, integrated within the course (written material, video and sound tapes, computer simulations, computer aided instruction), in which the written text has the major part. The written material is produced for the greater part by the Open University itself. In addition to its own texts, use is made of existing publications, books, parts of them and/or articles, which are combined to form a course component. The written material is supplemented in some cases by material for computer applications, practical instructions and guidance from the study centres.
The courses are developed at three levels, the first level comprising the introductory courses, the second level the acquisition of basic skills and insights and the third level a further theoretical, methodological and/or content depth.
Each course concludes with official exams. When an exam is passed, a fixed number (1, 2 or 3) of credits is gained, depending on the number of modules comprising the course.
In the study guide, a course catalogue, a short description is given of each course. The description contains the following elements:

- the primary field of study within which the course has been developed;
- the number of hours required for the course;
- the level of the course;
- the entry situation, which includes knowledge and

skills on which the course is predicated (the prior knowledge) and
- learning objectives, the objects of the course, in terms of knowledge and skills that the student should possess at the end of the course.

The structure and the organization of the course at the Open University offers maximum opportunities for a student's individual choice.
Flexibility is guaranteed by course structure, registration per course and the credit system. The subdivision of the courses into broad learning areas and the fact that the courses from one field can be part of study programmes in another increase the options available.
The student can make a highly personal choice from the courses on offer which relates to his/her wishes and preferences, in relation to occupations, interests, inclinations and/or social involvement.

In the following section, we will shortly review the three main modular course models, used at this university.

Modular course models

The modular course models of the first level are mainly based on the "study unit" model. First, we will describe the characteristics, the advantages and disadvantages of this basic model.

In terms of the study unit model a great deal of material is subdivided into learning units of approximately four hours, in which "new" material and revision alternate. A learning unit is an interrelated whole in terms of subject matter, instructions and (self)testing. This leads to the achievement of one or more learning objectives. The (self)testing allows the students to assess their acquired knowledge and insights.

The study unit model may be characterized as follows (Van den Boom, 1988):
- most of the study texts are newly written;
- frequent use of didactic tools, such as educational objectives, study hints, assignments and tests;
- the texts and didactic tools are integrated;
- the course is highly structured and is divided into a number of self-contained parts, called study units;
- the study material is put at the student's disposal in its entirety;
- the electronic media are an integrated part of the course design.

If the object is to transfer information as efficiently as possible to the students then the learning unit model is extremely suitable. It makes information as clear as possible and leads the student through the information systematically and stage by stage. The chance of the student getting stuck or lost in the material is minimal.

The advantages of the learning model are (Van der Linden, et al., 1987):

1. students receive optimal guidance by means of the instructions in the material;
2. at a given time, students know in time what is required of them;
3. the learning material is selected by the team, in terms of relevance and need;
4. students don't get stuck so easily, because the information is so clearly and fully presented and consequently students' problems are anticipated;
5. the study path is clearly indicated;
6. students who still have to learn how to study get a chance via study instructions etc.;
7. uncertainty on the part of the students about their progress and performance is minimalized by the introduction of didactic tools;
8. students respond positively to a model that allows them to study independently at the time and pace that suits them.

The application of the learning unit model has also shown that there are a number of disadvantages attached to it:

1. as the course is phased as a complete and sequential whole, the model is extremely linear;
2. students have little freedom, they have to follow the study path indicated;
3. as the courses are highly prestructured there is a danger of students becoming dependent on this sort of material which has consequences for their study abilities and skills in a efficient search for new information;
4. the model offers no opportunity for the student to work through large amounts of specialist literature using his own initiative;
5. everything has to be rewritten, which demands a great deal of time and creativity of the authors;
6. the model is less suitable for learning skills and attitudes;
7. as everything is fixed in a course, it is extremely difficult to adjust it to the needs of individual students.

Comparing the advantages and disadvantages, the Ou educationalists concluded that this model is fitting to the needs of students starting with first level courses (van den Boom, 1988). In order to counteract the disadvantages at higher levels, other models were to be introduced, such as the textbook/workbook model, the workbook-source material model and the essay/thesis model (Van den Boom, 1988; Van den Brink, 1989).

The most striking aspect of the textbook-workbook model is the fact that the subject matter is not offered to the students as an integrated whole; there is a separation of contents and didactic tools. The textbook contains the content-specific information of the course. In addition to the textbook there is a workbook. The workbook has a wide range of didactic clues which the student may use when studying the textbook. The workbook for instance contains an overview of objectives, self-assessment tests with matching feedback, cases, comments on the textbook, study hints, an index, introductions and summaries and a sample test. The advantage of the textbook-workbook model over the study unit model, is that it enables the students to experience the many ways in which authors present the subject matter in text books, articles, etc.
Another important characteristic of this course model is that it gives students a certain freedom in choice of their (self-)study strategy. Students are free to use the workbook or not.
In courses built on the base of the "workbook-source material" model, the workbook encourages students to use different information sources such as handbooks readers, audiovisual productions, etc. From the source material they extract information necessary to find the answers to questions, or solve problems, cases, etc. presented in the workbook. Mostly, the workbook only mentions possible sources, which the student would have to find or purchase himself. This course model also offers opportunities for a more problem-oriented approach. One could organize higher-level courses around the practising of skills such as information processing and application.

Finally, the essay/thesis model is most useful when the objective is to produce a written presentation such as an essay or a thesis. The course itself may consist of a short manual and the provision of support facilities by the university. These facilities may consist of brochures on for instance: "how to set up a good research project?" or "writing reports", but also personal supervision by university staff members or external experts (Van den Boom, 1988).

3. Prior knowledge and modular instruction

As we have stated earlier, in modularisation it is necessary to take account of the consequences related to components of education. One important aspect of education is the learner. First of all, modularisation is directed towards more efficient and more effective education in profit of the learner. According to the changing ideas in today's society on personal development, students will request a kind of instruction more fully in accordance with and appropriate with their personal characteristics and their prior knowledge state.
Second, modular instruction creates the opportunity for students to work at their own pace. Furthermore there is the opportunity for students to skip a module or to work through it more quickly on the basis of prior knowledge. This is the most radical phenomenon in respect of the return on instruction, both for the student and the institution.
It seems that not all the institutions working on the base of a modular structure do profit from these opportunities yet.

Theoretically the approach of modular education always should include a pretest to determine the level of the student. According to Goldschmid and Goldschmid this has the following consequences:

"If the student does not have all required prerequisites, he may need prior instruction. If he is already competent in the area of a particular module, he can proceed to a more advanced module or to one with a different content. Upon completion of a module the student is again evaluated. If the post-test indicates that the student has not achieved mastery of the module's objectives, he might be recycled through the module or through parts of it or he may take a remedial module. If he does succeed, he proceeds to the text (or, to another) module. The pre- and post-test also allow for empirical validation of the module itself."
The learner's options are charted in Figure 3.

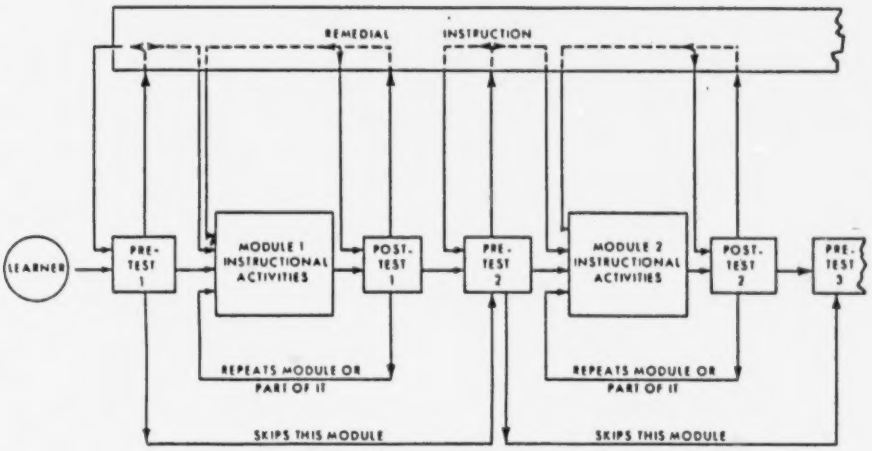

Figure 3: Flow chart of the learner's options in modular instruction (adapted from Goldschmid and Goldschmid, 1973).

This sort of approach actually makes it possible for students to follow individual paths as we described above, which relate to their prior knowledge. In this sense modular education is flexible and directed at individualization. There is always a spectrum of options offered in which prior knowledge in principle can be the determining factor in the choice. In this sense, it does not matter if the prior knowledge deficiencies are filled within the module itself, within a remedial module or by the presentation of a large knowledge base.

In this context, and in the light of returns to the institution and interinstitutional cooperation, the development of multifunctional modules has become a topic (de Wolf, 1988).
From the student's point of view, the domain specificity of the subject is important, and the learning process can be registered in several categories.
When a student gets information on a subject, the first question is how much of the information he or she can understand, i.e. how proficient he is in the terminology. Science usually has its own jargon which has to be learned. Secondly, scientific arguments often present technical or

scientific intellectual procedures, some even implicit ones, which have to be studied to be able to follow discussions on the subject. Thirdly, every discipline has its own knowledge patterns and views which one can only master through much pratice. Finally, every discipline requires domain-specific cognitive and other skills which one has to master.
With the help of these categories, and one can think of more, it is possible to order and organize study processes. Then alternative study paths within and between modules are really possible.
Nevertheless, valid and reliable information on the domain-specificity and on the student's prior knowledge state are the primary condition for the design of completely multifunctional modules.

The view that this type of flexible education on the basis of the stated flow chart is only rendered feasible by using computer based courses, may indeed be valid. Most forms of modular education offer a relatively vague indication of the required entry level. The Ou courses also are limited to indicating the concepts assumed to be known by students and the available literature.

A true assessment of the individual level with the resultant advantages does not occur. If one wants to adjust the return on education and allow the student to learn as efficiently as possible then it is necessary to explore these options. This last does seem to cause some trouble. Mapping a student's prior knowledge can be approached from various angles. Prior knowledge is more than just the knowledge acquired in earlier training and courses (Dochy, 1989). Experience which people acquire can to a degree influence the manner and the speed in which they learn to command new material. Furthermore, attention must be directed at relevant prior knowledge, in relation to the objectives to be pursued. Working slowly towards an ideal situation vis à vis the learning path to be followed both within and between modules can be adopted as the basis of a research based approach directed more explicitly at increasing returns.

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